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EXAMINER
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PADGETT, MARIANNE L

ART UNIT	PAPER NUMBER
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1762

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Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.  
09/070,908

Applicant(s)

Mitsunori Sakama

Examiner  
Marianne Padgett

Art Unit  
1762



-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

1) ☒ Responsive to communication(s) filed on 12/21/01 & 01/17/02

2a) ☐ This action is FINAL.

2b) ☒ This action is non-final.

3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

## Disposition of Claims

4) ☒ Claim(s) <sup>23-29,</sup> 31-50 and 58-129 is/are pending in the application.

4a) Of the above, claim(s) \_\_\_\_\_ is/are withdrawn from consideration.

5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.

6) ☒ Claim(s) <sup>23-29,</sup> 31-50 and 58-129 is/are rejected.

7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.

8) ☐ Claims \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

9) ☐ The specification is objected to by the Examiner.

10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are objected to by the Examiner.

11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved.

12) ☐ The oath or declaration is objected to by the Examiner.

## Priority under 35 U.S.C. § 119

13) ☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

a) ☐ All b) ☐ Some\* c) ☐ None of:

1. ☐ Certified copies of the priority documents have been received.

2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_

3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\*See the attached detailed Office action for a list of the certified copies not received.

14) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

## Attachment(s)

15) ☐ Notice of References Cited (PTO-892)

18) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_

16) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

19) ☐ Notice of Informal Patent Application (PTO-152)

17) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s). \_\_\_\_\_

20) ☐ Other:

Art Unit: 1762

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 23-29, 45-50, 58-59, 61-65, 67-82, 84-87, 89-104, 106-110, and 113-129 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kozuka in view of Gupta et al (6,289,843 B1) and (5,456,796) .

Claims 60, 66, 83 and 88 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kozuka in view of Gupta et al.(843 & 796) alone as applied above, or further in view of Mei et al., or Kaschmitter et al, or Yamazaki et al.

Contrary to applicant's assertion (p.18, response of 6/18/01), with the exception of claims 31-44, applicants' claimed invention is directed to plasma deposition of generic or  $\alpha$ -Si semiconductor, or of an insulating film, or an unspecified film (82, 87) , not thin film transistors (TFT). Claims 58, 64, 70, 76, 82, 87, 92 & 98 have the intended use in fabricating of TFT in the preambles, but no necessary use therefore in the actually claimed steps of the process. Deposition of 1 or 2 films does not make or necessitate a TFT.

Kozuka teaches deposition of multiple layer non-monocrystalline semiconductor devices using both single and multi chamber process, exemplified by deposition of amorphous silicon TFT

Art Unit: 1762

(thin film transistors), by forming successive layers in a manner such that a plasma atmosphere is constantly maintained from the start until the end of the film formation process, in order to protect the interfaces from damage by initial stages of plasma formation and from contamination (Abstract) as is typically found in discontinuous plasma processes (col. 2, line 57-col. 3, line 7). This process inherently has the plasma stability aspects discussed by applicants in their response (6/18/01). In col. 4, lines 38-49, Kozuka particularly teach that "since the plasma is continuously generated, the start and end of film formation can be achieved by changing the raw material gas. During film formation, therefore, the raw material gas is preferably used, not singly but as a mixture with a diluting gas" (emphasis added). The diluting gas is exemplified by  $H_2$ , which differs from the present claims by using  $H_2$  with silane, except it is noted that preferably does not mean its necessary, but that its optional and singly is possible, if not preferred. Also note that applicant's have unspecified "reactive gas" (except claims 62, 68, 73, 79, 85, 90, 95 & 101) does not exclude hydrogen with silane gas as the reactive gas, if it is separately supplied from the non-deposition hydrogen/discharge gas, which means use of reactive diluents (H is reducing) can read on claim language, although Kozuka shows a single  $H_2$  supply for each chamber of their multichamber system. In col.4, Kozuka further teaches "With the use of such mixed gas, when the supply of the raw material gas is terminated after the completion of film formation, the discharge is maintained by the diluting gas so that the fluctuation in plasma can be suppressed..." Therefore, Kozuka's teachings can be considered to directly address concerns for plasma stability. In col.4, lines 50-62 Kozuka discuss control of gas supply paths and use of predetermined flow rate for

Art Unit: 1762

achieving a stable and responsive supply of gas, however there is no explicit discussion of maintaining the overall flow rate during the transition from reactive gas to just diluting gas, as is now claimed in the application.

Also, Embodiment 1 (col. 5, lines 57-68+) indicates a process of keeping the pressure the same for the deposition and H-plasmas. "The diluting gas can be hydrogen, argon or helium..." (col. 4). Embodiments 2 (col. 6, line 55-col. 9, line 12) and 3 (col. 9, line 15-col. 10, line 22), form plasma deposited amorphous Si TFT films using silane gas and  $H_2$  as a diluent, with the first deposition being plasma deposited  $Si_3N_4$  insulating film, followed by films that read on claimed deposits. Reactant gas ( $SiH_4$ ) flow is stopped in each plasma chamber and the diluent (discharge) gas plasma continues in that chamber before transfer to the next chamber, where the diluent gas plasma is present before reactive gas starts to flow into the chamber.

Kozuka also differs from applicant's claims and probable intent by explicitly inputting and using  $H_2$  diluent gas during both deposition and non-deposition plasmas in their examples; and by stating a preference for the diluent gas ( $H_2$  or Ar or He) to be mixed with the reactant gas; and not teaching the same flow rates for total gas flow during and before/after the deposition, or during the transition between diluent and active gas flow, while applicant's only explicitly use hydrogen gas or "discharge gas" (which is equivalent to Kozuka's diluent gas during their non-deposition plasma), either before or after the amorphous silicon containing deposition and teach all flow rates are the same, possibly 100 sccm. From col. 4, line 50-62, it appears that the main reason the diluent gas is used with the reactant gas is so that only one gas flow needs to be

Art Unit: 1762

turned off, and thus avoids problems if one's flow control equipment has slow response. This is consistent with the claim limitation to maintain overall flow rate during gas transitions, but does not anticipate it. The examiner notes that it might also keep the reactive gas input site from accumulating particulates.

However, it is seen by the teachings of Gupta et al. ((6,289,843 B1):abstract; fig.2; col. 2, lines 48-58; col.4, lines 40-50; col.5, lines 5-57, especially lines 45-57 & (5,456,796): abstract; col.2, lines 50-54; col. 3, lines 16-38; col. 5, lines 30-50; col. 6, line 61-col. 7, lines 20 and 35-40; and claims 9-11, especially col. 5, lines 39-42) that for an inert plasmas gas, such as Ar or He, used for pre- or post-processing (deposition) plasma that prevents particle contamination of the substrate, that the inert gas may be stop simultaneous with start of the reactant gas, such that constant plasma is maintained and particle contamination prevented. While Gupta et al (796) does not discuss the pressure or flow used, constant plasma is consistent with constant pressure, and whether or not gas flow between steps is constant as will depend on pumping rate or efficiency. Gupta et al (843 B1) which contains analogous teachings to (796), explicitly discusses maintaining the rate of gas introduction, i.e. flow rate, substantially equal for inert gas and process gas, stating that "Maintaining such a uniform gas flow between step 220 [fig.2, set 7 maintain inert gas pressure] and 230 [introduce reactant gases & stop inert gas] provides for a more uniform deposition". Given the teachings of Gupta et al (796) & (843 B1) which are taught to be generally applicable to plasma processes, including depositions and processes exemplified by using silicon containing gases, such as TEOS or for silicon oxide deposition, it therefore would have

Art Unit: 1762

been obvious to one of ordinary skill in the art, that the diluent gas of Kozuka ( $H_2$  or Ar or He) need not have been mixed with the reactant gas, because that mixing is a preference not a necessity; the mixing is not needed for the chemical reaction involved in the deposition as Kozuka teaches use of hydrogen or inert gases equivalently; and either Gupta et al. shows that it is possible to achieve the objective of Kozuka (preventing contamination and achieving a full or nonfluctuating (stable) plasma before introducing reactant gas, (i.e., equivalent to no plasma on/off hysteresis) via switching from inert gas to reactant gas, instead of maintaining the inert or diluent gas flow throughout the sequence. Kozuka's teaching of using the same pressure would apply equally regardless of when diluent gases are used in order to maintain plasma and particle control. Gupta et al (843 B1) further provides both teaching and motivation to maintain uniform flow of gases between steps as is now claimed, because the more uniform deposition produced by such procedures would have been desirable in Kozuka. Obviously, if one equipment has poor gas flow timing control, one would not use the modification from Gupta et al, but where sufficient regulation abilities exist, one would have been further motivated by saving resources from wasteful or unneeded use, and fitting one's process to match one's apparatus' capabilities is a matter of competent workmanship. Furthermore, one of ordinary skill in the art would optimize their parameters in order to maintain the constant plasma or pressure as taught by the combination of references, such that depending on flow and pumping abilities of an apparatus, it would have been obvious to use the same total flow for both deposition and pre- or post - deposit plasma discharges, as it would have been expected to produce the taught constant pressure, if balanced

Art Unit: 1762

by the pumping. Furthermore, choice of particular flow rates will depend on particular apparatus configurations, chemical reaction, pumping, etc., and would have been expected to have been optimized accordingly, via routine extermination.

The timings for length of non-coating plasmas will depend on mechanical and electrical abilities of the particular plasma systems used, and would have been determined by routine experimentation by the competent practitioner. Note Kozuka discusses TFT devices in general and the presence of a gate electrode on the substrate before deposition of  $\text{Si}_3\text{N}_4$  and  $\alpha\text{-Si}$  layers on col. 7, lines 45-55.

Kozuka teaches preparation of an  $\alpha\text{-Si}$  TFT on a glass substrate (ie. insulating), where initial plasma deposition of an insulating layer of silicon nitride followed by  $\alpha\text{-Si}$  deposits is taught in embodiments 2, and as mentioned above Kozuka teaches maintaining plasma of the same pressure between deposits, and generally discusses the importance of the interface between amorphous Si and the insulating film (col. 3, lines 8-28), but does not specifically discuss silicon oxide as the insulating film, however as  $\text{SiO}_2$  and  $\text{Si}_3\text{N}_4$  are conventionally used as equivalent alternative dielectrics in semiconductor devices, it would have been obvious to one of ordinary skill in the art to substitute one for the other in the teachings of Kozuka, and that the same needs for plasma stability, particle control, etc... would have been applicable regardless of specific insulating material or film composition. Note that while applicant's claim the Si deposit, then the insulating film, there is no necessary order for their deposits, plus the teachings of either Kozuka



Art Unit: 1762

or Gupta et al, make it clear that the intermediate non-deposition plasma is important regardless of the order of deposited materials.

Alternately, any of the optional tertiary references show the use of silicon oxide layers as claimed. In Kaschmitter et al., see claims 20, 22 and 24; col. 4, line 49-col. 5, line 10 and col. 7, lines 25-27. In Yamazaki et al., see Abstract, col. 20, lines 15-49, especially 35-39 where silicon oxide and silicon nitride are taught to be equivalently used, and claims 1, 5, 7, 9 and 14. In Mei et al., see Abstract; col. 1, lines 44-49; col. 2, lines 33-66, especially lines 58-60; col. 3, lines 1-6, where  $\text{SiO}_2$  is seen to be used before  $\alpha$ -Si deposits in TFT device manufacture. Hence, use of silicon oxides as claimed, would have been an obvious alternative to Kozuka's taught silicon nitride as it has been shown to be a known equivalent alternative thereto in analogous processes and structures.

3. Claims 31-44 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kozuka in view of Gupta et al (796) & (843 B1), as applied to claim 23-29, 45-50 and 58-129 above, and further in view of Mei et al., or Kaschmitter et al., or Yamazaki et al.

These claims differ from the combination of Kozuka and Gupta et al in requiring that the amorphous Si containing film be crystallized using laser light, however the references of Mei et al., Kaschmitter et al. and Yamazaki et al. already introduced above, show that it is old and well known to use lasers to induce crystallization in  $\alpha$ -Si layers in TFT structures (Abstracts, previously cited sections, plus), hence it would have been obvious to one of ordinary skill in the art to further treat the structures produced in Kozuka (as combined with Gupta et al.) as shown in

Art Unit: 1762

any of these ternary references, because these conventional laser annealing techniques are shown to be desirable for TFT devices, hence expected to be effective for crystallizing the amorphous deposits of Kozuka for TFT end uses as described by the ternary references.

4. Czubatyj et al. was cited as equivalent to Mei et al, Kaschmitter et al., and Yamazaki et al. for laser crystallization of  $\alpha$ -Si in TFT devices, and for teachings of interest on the alternative use of  $\text{SiO}_2$  or  $\text{Si}_2\text{N}_4$  deposited by PECVD for gate insulators used in those devices.

5. Applicant's arguments with respect to claims <sup>23-29,</sup> 31-50 & 58-129 have been considered but are moot in view of the new ground(s) of rejection. *MLP*

6.. Any inquiry concerning this communication should be directed to M. L. Padgett at telephone number (703) 308-2336 on M-F from about 8 am to 4:30 pm, and FAX # 305-5408 or 872-9310 (official), 872-9311 (after final official), and (703) 305-6078 (unofficial).

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02/12/02